

WHAT IS CLAIMED IS:

1. A flapping apparatus having a body and a pair of wing portions provided on left and right sides with respect to forward and backward directions of the body, wherein:

5 said wing portions generate, by their motions, fluid force on surrounding fluid,

the fluid force being capable of generating, on the flapping apparatus, a lift force larger than gravity of the flapping apparatus in a direction opposite to the gravity of the flapping apparatus;

10 said flapping apparatus comprising, for at least one of said wing portions:

a wing shaft having one end fixed on the wing portion and the other end attached to the body, for transmitting driving force of a driving source to the wing portion;

15 a central point rotating member capable of rotating the wing shaft about a prescribed central point along a plane parallel to the forward and backward direction and to the left and right direction orthogonal to the forward and backward direction;

20 a wing shaft rotating member that follows the rotation of the wing shaft about the prescribed central point without using any driving force from the driving source and rotates the wing shaft about a central axis of rotation parallel to the direction of extension of the wing shaft;

a stopper limiting range of rotation of the wing shaft rotating member so that rotation angle of the wing shaft is limited within a prescribed range; wherein

25 the wing shaft rotating member has its positional relation relative to the central point rotating member fixed when the stopper is functioning, so that rotation of the wing shaft is caused by the rotation of the central point rotating member, and

30 the wing shaft rotating member rotates as the central point rotating member rotates when the stopper is not functioning, so that rotation of the wing shaft is caused by the rotation of the wing shaft rotating member.

2. The flapping apparatus according to claim 1, wherein  
said stopper is provided on at least one of said central point rotating  
member and said wing shaft rotating member.

3. The flapping apparatus according to claim 1, wherein  
said stopper abuts either one of said wing shaft rotating member and  
said central point rotating member to stop rotation of said wing shaft  
rotating member; and

5       coefficient of friction of said stopper and coefficient of friction of  
either one of said central point rotating member and said wing shaft  
rotating member is set such that positional relation between said stopper  
and one of said central point rotating member and said wing shaft rotating  
member does not change while said stopper is in abutment with either said  
10       central point rotating member or said wing shaft rotating member.

4. The flapping apparatus according to claim 1, wherein  
said central point rotating member includes a first disk;  
said wing shaft rotating member includes second and third disks;  
said second and third disks are provided to have same central axis of  
5       rotation, and when the stopper is not functioning, said second and third  
disks rotate as said first disk rotates, with outer circumferential surfaces of  
said second and third disks being in contact with a main surface of said  
first disk; and

10       said wing shaft is fixed on the second disk and when the stopper is  
not functioning, said wing shaft rotates as the second disk rotates, and said  
wing shaft passes through a through hole of said third disk and when the  
stopper is not functioning, the wing shaft rotates being in contact with the  
through hole.

5. The flapping apparatus according to claim 4, further comprising  
a fourth disk having a main surface opposed to the main surface of  
said first disk and being in contact with outer circumferential surface of  
said second disk; wherein

5           central axis of rotation of said fourth disk is coaxial with central axis  
of rotation of said first disk, and said fourth disk rotates following the  
rotation of said second disk.

6.   The flapping apparatus according to claim 4, wherein  
frictional force generated between the main surface of said first disk  
and outer circumferential surface of said second disk is larger than  
frictional force generated between portions other than the main surface of  
5   said first disk and said shaft.

7.   The flapping apparatus according to claim 4, wherein  
the main surface of said first disk and the outer circumferential  
surface of said second disk have recesses and protrusions that mate with  
each other.

8.   A flapping apparatus having a body and a pair of wing portions  
provided on left and right sides of the body with respect to forward and  
backward directions, wherein

5           said wing portions generate, by their motions, fluid force on  
surrounding fluid,

          said fluid force can generate, on said flapping apparatus, a lift force  
larger than gravity of said flapping apparatus in a direction opposite to the  
gravity of said flapping apparatus;

10          said flapping apparatus comprising, for at least one of said wing  
portions:

          a first wing shaft having one end fixed on said wing portion and the  
other end attached to said body, for transmitting driving force of a driving  
source to the wing portion;

15          a second wing shaft having one end fixed on said wing portion and  
the other end attached to said body, for transmitting driving force of a  
driving source to said wing portion;

          a central point rotating member capable of rotating said first wing  
shaft about a prescribed central point along a plane parallel to the forward

20 and backward direction and to the left and right direction orthogonal to the forward and backward direction; and

a wing shaft rotating member that follows the rotation of the said wing shaft about the prescribed central point without using any driving force from a driving force and rotates said second wing shaft about a central axis of rotation crossing said first wing shaft at a prescribed angle; 25 wherein

said wing portion is provided spanning between said first and second wing shafts, and change in the positional relation between said first and second wing shafts forces said wing portion to be twisted.

9. The flapping apparatus according to claim 8, wherein said central point rotating member includes a disk;

5 said wing shaft rotating member includes a truncated cone that is a portion of a first cone from which a second cone extending from the vertex of the first cone to a prescribed distance is removed;

said truncated cone rotates as said disk rotates, with a circumferential surface being in contact with the main surface of said disk;

said second wing shaft is provided on a circular surface of said truncated cone; and

10 an axis passing through the center of the circular surface of said truncated cone forms a prescribed angle with said second wing shaft.

10. The flapping apparatus according to claim 9, wherein

the main surface of said disk and the outer circumferential surface of said truncated cone have recesses and protrusions that mate with each other.

11. The flapping apparatus according to claim 8, further comprising:

5 a stopper limiting range of rotation of said wing shaft rotating member so that rotation angle of said second wing shaft is within a prescribed range; wherein

said wing shaft rotating member has its positional relation relative to said central point rotating member fixed when the stopper is functioning, so that rotation of said first and second wing shafts is caused by the rotation of said central point rotating member; and

10        said wing shaft rotating member rotates as said central point rotating member rotates when the stopper is not functioning, so that rotation of said second wing shaft is caused by the rotation of said wing shaft rotating member.

12. The flapping apparatus according to claim 11, wherein said stopper is provided on at least one of said central point rotating member and said wing shaft rotating member.

13. The flapping apparatus according to claim 11, wherein said stopper abuts either one of said wing shaft rotating member and said central point rotating member to stop rotation of said wing shaft rotating member; and

5        coefficient of friction of said stopper and coefficient of friction of either one of said central point rotating member and said wing shaft rotating member is set such that positional relation between said stopper and one of said central point rotating member and said wing shaft rotating member does not change while said stopper is in abutment with either said  
10        central point rotating member or said wing shaft rotating member.

14. The flapping apparatus according to claim 8, further comprising a wing edge having a flexible wire provided to connect a tip end of said first wing shaft and a tip end of said second wing shaft; wherein

5        said wing portion is formed at a portion surrounded by said first wing shaft, said second wing shaft and said wing edge.

15. The flapping apparatus according to claim 14, wherein said wing edge is formed of a member having such flexibility that does not cause plastic deformation when relative positional relation

between said first and second wing shafts changes.

16. The flapping apparatus according to claim 14, wherein said first and second wing shafts are formed by hollow cylindrical members; and

5 said wing edge is inserted into each of the hollow portions of said cylindrical members, rotatable about each of axes extending in the directions of extension of each of the first and second wing shafts in each of the hollow portions, and provided not to come off from each of said first and second wing shafts.

17. A flapping apparatus having a body and a pair of wing portions provided respectively on left and right sides of the body with respect to the forward and backward directions, comprising:

5 a wing shaft having one end fixed on said wing portion and the other end attached to said body, for transmitting driving force of a driving source to said wing portion;

10 a central point rotating mechanism capable of rotating said wing shaft about a prescribed central point along a plane parallel to the forward and backward direction and to the left and right direction orthogonal to the forward and backward direction;

a wing shaft rotating mechanism that follows the rotation of said wing shaft about the prescribed central point without using any driving force from a driving source and rotates the wing shaft about a central axis of rotation parallel to the direction of extension of the wing shaft; wherein

15 said wing portions generate, by the rotation of said wing shaft about said central axis of rotation, fluid force on surrounding fluid, said fluid force capable of generating, on said flapping apparatus, a lift force larger than gravity of said flapping apparatus in a direction opposite to the gravity of said flapping apparatus.

18. The flapping apparatus according to claim 17, further comprising

5        an amplitude center moving mechanism capable of moving center of  
amplitude of rotation of said wing shaft about the prescribed central point,  
along a plane including the forward and backward as well as left and right  
directions.

19.    The flapping apparatus according to claim 18, wherein  
5        said amplitude center moving mechanism is capable of moving the  
center of amplitude while said central point rotating mechanism is rotating  
said wing shaft.